

Operating Instructions

MAICO MA 51





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1 Introduction

Thank you very much for purchasing a quality product from the MAICO family. This MA 51 audiometer is manufactured to meet all quality and safety requirements, and has been certified with the CE-symbol according to Medical Directive 93/42/EEC.

In designing the MA 51 we placed particular importance in making it a user-friendly device, meaning its operation is simple and easy to understand. And because MA 51 functions are software controlled, upgrading later to new, extended measurement functions will be simple and inexpensive. That means that you have invested in a device that will adjust to your future needs.

This user manual should make it as easy as possible for you to become familiar with the functions of the MA 51. Please open out the flap of illustrations on the last page. The description of the position (e.g. ⑤) of controls, displays and connections, found again in the text, will make it easier for you to learn how to operate the MA 51.

If you have problems or have ideas for further improvements, please get in touch with us. Simply call.

Your MAICO-team



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2 Description

The MA 51 is an audiometer for pure tone and speech audiometric tests. It can be used for ENT diagnostics and hearing aid fittings in the office, and for mobile audiometry in clinics, homes and abroad.

Tests can be performed using the DD 45 headphones (AC), B 71 bone conduction receiver (BC) or optional insert phones and loudspeakers (FF). Built-in test signals are pure tone, pulse tone, warble tone, narrow band and broadband noise. The MA 51 has a microphone for live speech audiometry and an input for an optional tape/ CD player with speech test material.

The MA 51 audiometer delivers 11 air conduction (AC) test frequencies from 125 Hz to 8 kHz, with levels from -10 dB_{HL} to 120 dB_{HL}.

Bone conduction (BC) can be tested with 10 test frequencies from 250 Hz to 8 kHz with levels from -10 dB_{HL} to 80 dB_{HL} (with the standard bone conductor B 71 the frequency range is limited from 250 Hz to 6 kHz).

The optional insert phones EAR 3A submit levels from -10 dB_{HL} to 120 dB_{HL} with 11 test frequencies from 125 Hz to 8 kHz.

Optional loudspeakers are available for free sound field measurements (FF). The portable loudspeakers MAICO SBC have a dynamic range from -10 dB_{HL} to 80 dB_{HL} at 1m distance, for nine test frequencies from 500 Hz to 8 KHz. The passive loudspeakers Canton (not available in the USA), deliver levels up to 80 dB_{HL} at 1m distance over the entire frequency range from 125 Hz to 8 kHz.

The MA 51 also has separate line level outputs for an external amplifier.

The hearing level is controlled independently for each channel by two detented dials on the left and right of the instrument which can be operated from the side or the top. The level steps are 5 dB and can be changed to 2 dB. The signal STIM bar and the frequency up/down keys are just beside the level control knobs for easy one handed control of level, frequency and signal presentation.

The bright LED-display shows level, frequency and other information for each channel.

As a result of modern microprocessor technology, the MA 51 is easy to use and is extremely reliable.

The audiometer is designed to be extremely service friendly. Automatic test programs make trouble shooting and the yearly calibration as easy as possible.



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PC-Interface:

A serial RS 232C interface for data transfer to a connected computer is built in. The optional MAICO-audiometry module for NOAH enables the automatic data transfer of all test results of the MA 51, like tone and speech audiogram.

For more information see chapter 8.



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3 Getting started

3.1 Unpacking your instrument

Your MA 51 was carefully inspected and packed for shipping. However, it is a good practice to thoroughly inspect the outside of the shipping box for signs of damage. If any damage is noted, please notify the carrier immediately.

Carefully remove the instrument from the shipping box. Remove the plastic bag from the instrument and inspect the case for any damage.

Notify the carrier immediately if any mechanical damage is noted. This will assure that a proper claim is made. Save all packing material so the claim adjuster can inspect it as well. Notify your dealer or MAICO when the adjuster has completed the inspection.

SAVE ALL THE ORIGINAL PACKING MATERIAL AND THE SHIPPING CONTAINER SO THE INSTRUMENT CAN BE PROPERLY PACKED IF IT NEEDS TO BE RETURNED FOR SERVICE OR CALIBRATION.

All accessories are already packaged in the compartment connected with the MA 51. Please check that all accessories listed below are received in good condition. If any accessories are missing or damaged, immediately notify your dealer or MAICO.

Standard accessories:

- 1 Headphone DD 45
- 1 Bone conduction receiver B 71 with headband
- 1 Patient response switch
- 1 power cable
- 1 microphone with stand (only for export outside USA)
- 1 audiogram form (50 sheets)
- 1 monitor headset with microphone (USA only)
- 5 sound room cords (USA only)

Calibration of the device:

The instrument, headphones, bone conduction receiver as well as the optional insert phone and loudspeaker match one another and have the same serial number (e.g. 6631520). Because they have been calibrated with this particular instrument, use of other transducers is not allowed. If one of the acoustic transducers is replaced, the instrument must be recalibrated.

The use of non-calibrated audiometers leads to incorrect measurements!

3.2 Preparing the MA 51 for use

The MA 51 with its integrated compartment for the accessories is perfect for portable use. The rugged housing, light weight and the comfortable handle make it easy and convenient to transport the instrument. Carry it, as shown, with the bottom away from the leg. That helps protect the front cover from damage, and due to the asymmetrical handle position it provides more space for your leg.

To get started first move the handle under the housing. Unlatch the cover by pressing in the two black locks located on the left and right sides near the front of the instrument. Open the front cover and rest it on the back cover of the accessory compartment. To open the compartment, press the two black locks in the upper middle of the instrument. Open the compartment cover as seen in picture 2. Take the headphone, the bone conduction receiver, the patient response switch and the microphone out of the compartment and connect the power cable to power. The MA 51 operates with voltages from 96 to 240 V~ AC, 44 Hz to 440 Hz. To avoid pinching the cables when closing the cover, lay the cables in the slots provided.

Close the back cover and latch it with slight pressure. You can place the microphone or a tape or CD-player on top of the cover (see picture 3).

The MA 51 should be operated in a quiet room, so that the audiometric examinations are not influenced by outside noises. For use in noisier environments headphones with optional sound insulation muffs are available.

Electro-medical instruments, which emit strong electromagnetic fields (e.g. microwaves - radiotherapy devices), can influence the function of the audiometer. Therefore the use of these instruments is not allowed in close proximity to the audiometer.

The test room must be at normal temperature, usually 15°C / 59°F to 35°C / 95°F, and the instrument should be switched on about 10 minutes before the first measurement to guarantee precise measuring results. If the device has been cooled down (e.g. during transport), please wait until it has warmed up to room temperature.



Picture 1 Transport of MA 51



Picture 2 Portable with open cover



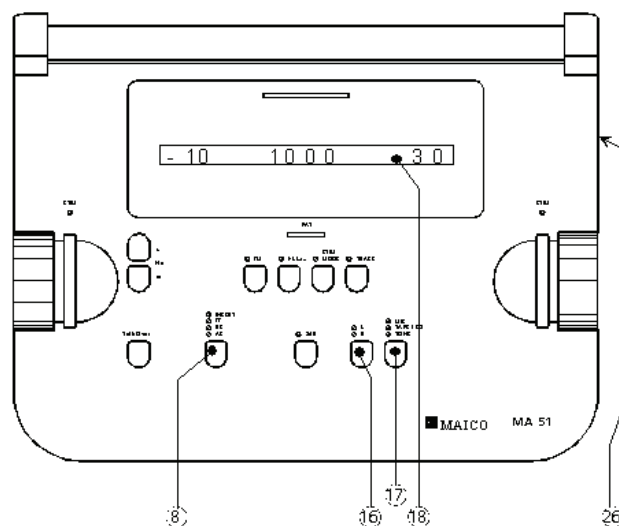
Picture 3 MA 51 in operation

3.3 Getting familiar with the MA 51

Turn on the instrument with the power switch ⑫ which is located at the right side of the MA 51. The device performs its initial test and auto calibration. If an error is detected the test is stopped and a description of the error code is shown on the LED-display ⑮. In this case please contact your local dealer or service.

If the test is passed, the instrument is setup to air conduction and pure tone for the right ear and narrow band masking noise for the left ear. The corresponding LEDs above the receiver ⑧, the signal ⑮ and the test channel selector ⑮ are lighted. The frequency is set to 1 kHz and the level to 30 dB_{HL} for the right test channel and to -10 dB for the left masking channel. All these settings are also shown on the display ⑮ (see picture 5).

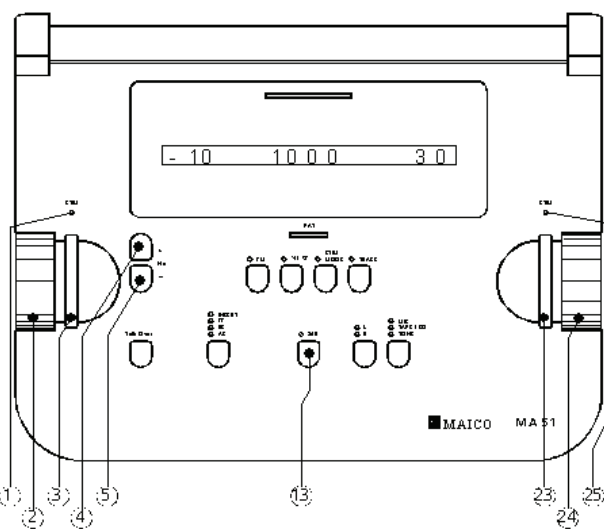
The hearing level can be easily adjusted with the right knob ⑮ and the masking level with the knob ② on the left side of the instrument. For optimal convenience these level control knobs are usable from the top or the side of the instrument. They are detented in 5 dB steps. You can adjust the level step to 2 dB with button ⑬. The corresponding LED lights when 2 dB level step is selected. The STIM bars ⑬ and ⑮ are located beside the level control knobs ②, ⑮. The STIM LED ① light up when you press the STIM bar ⑮ to present the test signal. The STIM LED ① lights continuous because the masking noise is continuous presented. The frequency is changed with up ④ and down ⑤ buttons. The design of the MA 51 makes it easy to control level, signal presentation and frequency with one hand.



Picture 4 MA 51 power switch, display and selection buttons receiver, signal and channel



Picture 5 MA 51 display with initial settings

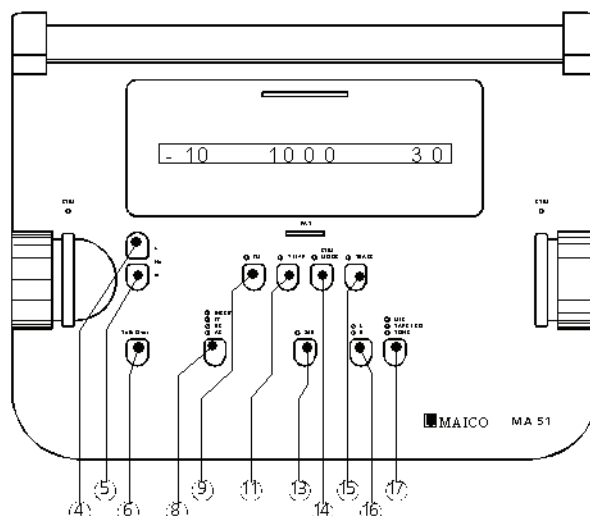


Picture 6 MA 51 level and frequency control

3.3.1 Using the keyboard of the MA 51

All main functions of the MA 51 are directly accessible by pressing a single button. Not frequently used procedures like the calibration of the speech source are hidden as a "second level function". To select this function just press the addressed button more than two seconds. A user menu for the customization of the MA 51 is available for advanced users (see chapter 6). Following is the description of the main and second level functions of each button:

- ④ frequency up:
change to next higher frequency
- ⑤ frequency down:
change to next lower frequency
- ⑥ talk over microphone:
switches on the talk over microphone as long as the button is pressed. The level can be adjusted with the knobs ② or ⑭. The actual value is displayed in dB_{HL} at the right side of the LED-display ⑮.
- ⑧ receiver selector:
changes the receiver from AC to BC or FF or INSERT (if option assembled). The lighted LED above shows the current selection.
2nd level: Calibration of monitor phone or talk back microphone (see chapter 6.11)
- ⑨ FM - modulation (warble tone):
changes test signal from pure tone to warble tone.
2nd. Level: to enter the user menu press button during power on.
- ⑪ pulse tone:
enables pulsing of pure tone or warble tone.
- ⑬ 2 dB level step:
selects 5 dB or 2 dB level step.
- ⑭ stim mode:
changes the signal presentation from presenter to interrupter mode.
- ⑮ tracking function:
enables the automatic tracking (see chapter 4.4 masking).
- ⑯ channel selector key:
selects the test ear. Right, left and binaural are possible settings.
2nd. Level: selects test mode HL, UCL, MCL for selected receiver (see chapter 4.2)
- ⑰ signal selector key:
changes the test signal from pure tone to tape/CD or microphone
2nd level: Calibration of CD or microphone (see chapter 6.13)



Picture 7 MA 51 keyboard



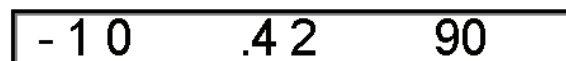
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3.3.2 The display of the MA 51

The bright LED-Display ® of the MA 51 shows levels, frequency and test results. The display shows the individual settings for the left channel on the left and the right channel on the right. The frequency or the speech score are displayed in the middle. Also the position of the dot in the middle indicates the kind of measurement. If the dot position is left from the center HL test is indicated. The dot in the center stands for UCL measurement and a dot right from the middle is MCL measurement. The example picture 8 shows the initial setting for AC threshold test. The right test channel is set to 30 dB_{HL}, the left masking channel is set to -10 dB_{HL} narrow band noise for masking. The test frequency is 1000 Hz and the test is a HL measurement (dot left from the middle).



Picture 8 MA 51 display for pure tone HL-test



Picture 9 MA 51 display for speech UCL-test

Picture 9 shows the display for a speech UCL-test. In the middle of the LED-display ® the result of speech discrimination (.42) in per cent are shown. The dot right from the center indicates that a UCL-test is done. The dot in the middle stand in speech mode for single syllable test. The dot left from the center stands for multi syllable speech test.

4 Pure tone audiometry

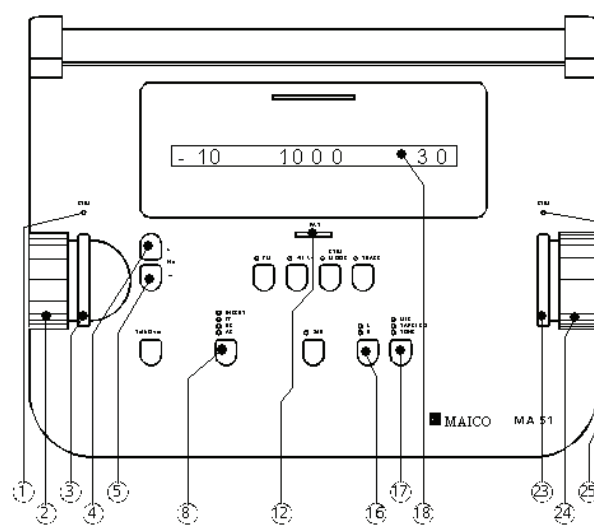
4.1 Air Conduction (AC) Testing

In the hearing threshold test, the hearing threshold of the patient is measured in comparison with the normal hearing threshold for air conduction. The test is started on the ear with better hearing.

- The patient should sit at a distance of at least 1 m from the device.
- Eliminate any obstructions which will interfere with the placement of the earphone cushions on the ear (i.e. hair, eyeglasses).
- Ensure the headphones are put on correctly. Red side on the right, blue side on the left. Adjust the headband of the headphones so that the receivers are at the correct height (the sound output grid ⊗ exactly facing the ear canal).
- Start with the "better" indicated ear at 1 kHz. (After switching on, the frequency is automatically set to 1 kHz.) In the following example we assume that the right is the "better" ear.
- Set the receiver selector ⑧ to AC and the signal selector ⑰ to TONE.
- Set the left level control knob ②④ to a value just below expected hearing loss.
- Explain to the patient that he should press the button of the patient response switch if he just hears the test tone.
- Press the STIM bar ②③ for a certain time to present the test tone. The STIM LED ②⑤ should light on.
- If the patient hears the test tone, the patient response display ⑫ lights red. In this case decrease the level with the level control knob ②④. Proceed with presenting the test signal as described before.
- If the patient doesn't hear the test tone, increase the level with the level control knob ②④. Proceed with presenting the test signal as described before.
- When you find a stable threshold value, note the level and frequency. If the MA 51 is connected to a PC, the value was stored with your last STIM presentation.



Picture 10 Headphone



Picture 11 MA 51 controls and display for airconduction threshold test



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- Test through the frequencies. Starting at 1 kHz, set the higher frequencies first then the lower frequencies.
- Use the frequency up key ④ to select the higher frequencies and use the frequency down key ⑤ to select the lower frequencies.
- Select the next frequency, increase the level again and proceed with presenting the test signal as described before.
- Once all frequencies are tested choose the poorer ear and repeat the hearing threshold test. You can do this just by pressing the test ear button ⑭. The corresponding LED **L** lights and you test the left ear using the controls on the right side. The masking is controlled with the level knob ② on the left side of the instrument. (For masking see chapter 4.4).
- The correct marks in an audiogram are: O (red) = right and X (blue) = left

Binaural tone audiometry: For tone presentation one both ears press the channel selector button ⑯ until both LEDs **R** and **L** light. (Pressing the button ⑯ several times changes the test channel from R (right) to **L** (left) to **RL** (binaural) to **R** and so on). The hearing level for the left ear is now adjusted with the level control knob ② and the knob ⑳ controls the level for the right ear. The test signal can be presented with the according STIM bar ③ and ㉓.

Pulse tone: If required, the test can also be performed with a pulsed tone. Press the PULSE button ⑪ and the pure tone will be switched 0.25 s on and 0.25 s off.

Warble tone: If required, the test can also be performed with a warble tone. Press the FM button ⑨ and the pure tone will frequency modulate. The warble tone can also be pulsed as described before.

For hygienic reasons it is important to clean the ear cushions of the headphone (see chapter 9).

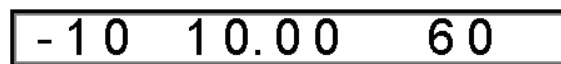
4.2 Uncomfortable Hearing Level (UCL) Testing

Testing of UCL can be measured using pure tone stimuli or speech (live voice or tape/CD). The purpose is to determine the dB level at which the stimuli becomes uncomfortable to the patient. This information is valuable for determining the patients upper dynamic range limit for proper hearing aid fittings and for determining symptoms of recruitment.

Warning! Because the UCL test uses high sound pressure levels, it is extremely important to perform this test using the utmost caution to avoid damaging the ear. To prevent the possibility of extreme discomfort by the patient, it is important to start the test with levels near the patients MCL (Most Comfortable Level).

The UCL level is described as the level between very loud and loud perception of the test signal.

- Press the test channel selector button ⑯ longer than 2 seconds. The dot in the middle of the LED-display ⑱ moves to the center of the display. (see picture 12).
 - Start as described in chapter 4.1 with a test level of 60 dBHL.
 - Present the tone briefly (max. 1s)
 - If the signal was recognized by the patient as not uncomfortable increase the level and proceed as described before.
 - If the signal was uncomfortable for the patient note the values.
 - Proceed accordingly with other test frequencies.
- For hygienic reasons it is important to clean the ear cushions of the headphone (see chapter 9).



Picture 12 MA 51 display for UCL-test left

4.3 Bone Conduction (BC) Testing

Bone conduction, i.e. the transmission of sound waves through the skull directly to the inner ear conveys information about the function of the inner ear. For a neural hearing loss the values of air conduction (chapter 4.1) and bone conduction are the same. In this case a hearing loss of the middle ear can be eliminated.

- Place the bone conduction receiver so that the flat, circular side of the transducer **Y** is placed on the mastoid, at the noticeable ledge of the cranial bone behind the auricle (see picture 14). The other side of the headband is placed in front of the opposite ear.
 - Set the receiver selector ⑧ to BC and the signal selector ⑰ to TONE.
 - Perform the test the same way as for air conduction (see 4.1). Enter the measurements for all frequencies on the form, connect all points with dotted lines marked on the audiogram form as follows: > = right and < = left
- For hygienic reasons it is important to clean the bone conductor (see chapter 9).



Picture 13 Bone conductor



Picture 14 correct seating of the bone conductor

4.4 Masking of the opposite ear

The basics of masking are explained below. To begin testing immediately, please go directly to 4.4.3 Manual masking.

4.4.1 Crossover:

When measuring a pure tone audiogram you assume that the measured hearing threshold is correct. But if you recognize that sound is also transmitted through bone conduction over the entire skull it is probable that the opposite ear has also received sound. This is called "crossover".

Crossover can also occur when measuring air conduction because a small amount of air conducted sound is received by the skull and transmitted by bone. Whether the crossover signal can be heard by the opposite ear depends on its inner ear function.

Relevant to crossover is the sound level which is received by the opposite ear. The difference between the original test signal at the test ear and the received signal at the opposite ear is called "interaural attenuation".

For bone conduction measurement the interaural attenuation is 0 to 15 dB. Bone conduction crossover is therefore possible even with a slight difference in hearing loss between ears.

Important: Please advise the patient to tell you in which ear he hears the test signal. It is thereby easier to detect crossover.

4.4.2 Masking theory:

To ensure that the patient will not experience crossover you must mask the opposite ear. Masking increases the hearing threshold of the opposite ear.

The masking is done with a noise signal which is transmitted by the headphone. For pure tone audiometry a narrowband noise is used. This noise changes its center frequency according to the frequency of the test signal.

4.4.3 Manual masking:

If you have to mask use the common masking rules. See chapter 7 for recommended literature.

Masking is an important part of practical audiometry. It is necessary to be familiar with this topic to avoid errors which would lead to a wrong diagnosis.

- Select the ear you like to test with the channel selector key ⑩. For the opposite ear narrow band masking noise is automatically set.
- Adjust the required masking level with the level control knob ②.
- Notice that the masking sound is continuously presented for effective masking. You can interrupt the masking signal by pressing the corresponding interrupter key ③.



Picture 15 Headphone

- To mask when performing bone conduction testing, place the headphone on the opposite ear so that the receiver is at the correct height (the sound output grid ⊗ exactly faces the ear canal). Adjust the headband of the headphones. The receiver on the side where the bone conductor is placed should sit directly on the cheek bone.

The marking for air conduction with masking should be done with the symbols ▲ = the right side and ■ = the left side on the audiogram form. The marking for bone conduction with masking should be done with the symbols [= the right side and] = the left side on the audiogram form.



Picture 16 correct seating of the bone conductor

4.4.4 Automatic masking:

With the manual masking, as described before, you have to readjust the masking level every time you change the test signal level. The MA 51 has a tracking feature for easy masking.

- Adjust for the test signal using the level control knob ④, then with the masking level control knob ② adjust for the corresponding masking level.
- Now press the TRACK button ⑤. The masking level is automatically changed if you adjust the test signal level. (e.g. if the test level was 30 dB and the masking level 50 dB and you change the test level to 45 dB the masking level is automatically adjusted to 65 dB.



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5 Speech audiometry

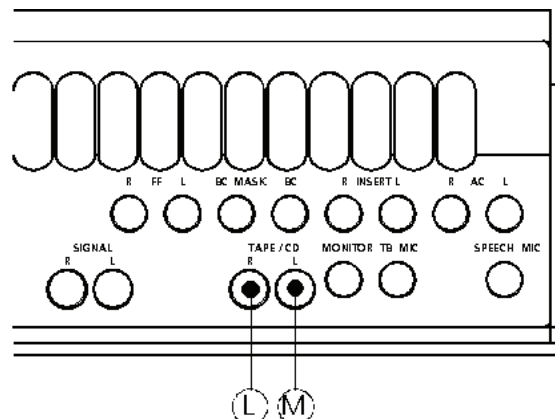
5.1 Connecting the speech source

5.1.1 Connecting of CD-Player or Tape

To conduct speech tests using speech test material you can connect a CD- or tape-player to the MA 51. Use a standard phono plug cable to connect the right and left outputs of the device with the corresponding inputs \textcircled{M} and \textcircled{L} on the rear panel of the MA 51 (see picture 17). To avoid pinching the cables when closing the cover, lay the cables in the slots provided.

If you are using a small portable CD-player or tape you can place it on top of the cover of the MA 51 similar as shown in picture 18 for the microphone. This saves space and makes the usage of the CD-player or tape very convenient.

Caution: If you are using a CD- or tape-player powered by electrical current, the player must meet the electrical safety requirements, such as IEC 601-1 or UL. This is to avoid electrical shock of either the patient or you. If you are not sure if your player meets these requirements it is safer to use battery power.



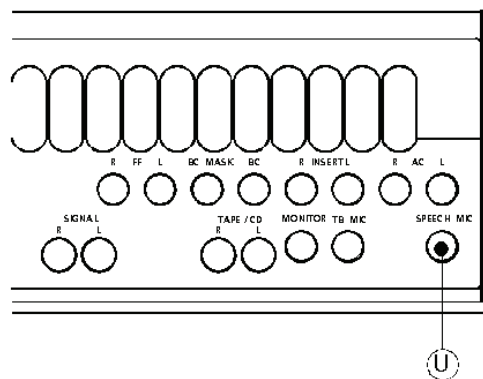
Picture 17 MA 51 rear panel with TAPE/CD input



Picture 18 MA 51 in operation with microphone for live speech audiometry

5.1.2 Connection of Microphone

Connect the microphone to the SPEECH MIC connector \textcircled{U} on the rear panel of the MA 51 (see picture 19). To avoid pinching the cables when closing the cover, lay the cables in the slots provided. Place the microphone on top of the cover of the MA 51 (as shown in picture 18). The microphone can be used for live speech audiometry and communication with the patient. If your instrument is supplied with a combination monitor/mic headset, connect the phone plug labeled E with the SPEECH MIC connector \textcircled{U} .



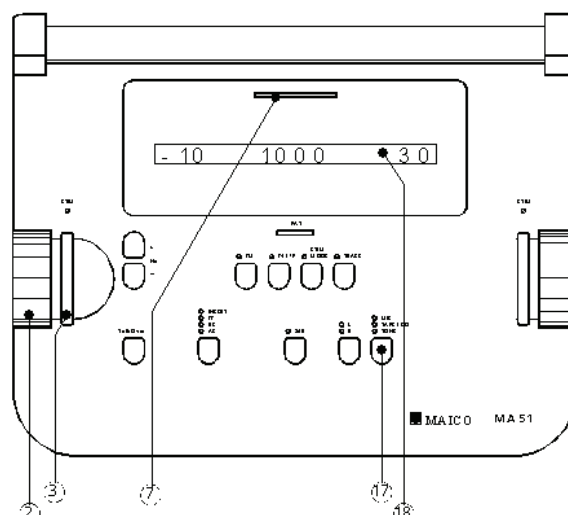
Picture 19 MA 51 rear panel with SPEECH MIC input

5.2 Speech calibration

5.2.1 Calibration of the CD or tape with speech test material

The MA 51 must be calibrated to the particular speech test material in use to ensure valid test levels. That means every time you change the CD or tape you must recalibrate the instrument.

- To calibrate the Tape/CD speech input select TAPE/CD with the SIGNAL selector key ⑰.
- Press the SIGNAL key ⑰ longer than 2 seconds.
- In the middle of the display ⑱ the text SCAL appears. You also see the actual settings in % of the maximum calibration for both channels (see picture 21).
- On every CD or tape with speech test material you have a reference signal, such as a reference tone or speech simulating noise.
- Perform the reference signal with Tape or CD.
- Use the left knob ② to adjust the level until the VU-meter ⑦ shows all yellow and one green light.
- If one or more red lights are on, reduce the level using the knob ②.
- Store the calibration by pressing the STIM bar ③.



Picture 20 MA 51 controls and displays for speech calibration



Picture 21 MA 51 display with speech calibration

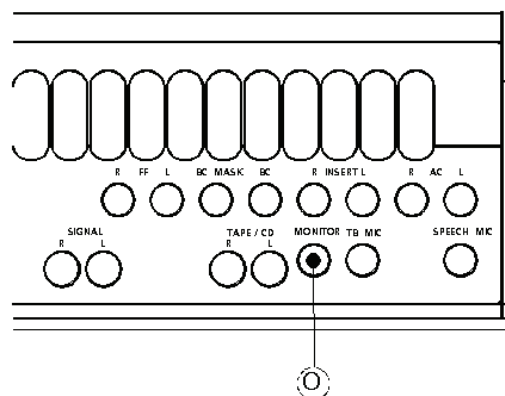
5.2.2 Calibration of the microphone for live speech test

- To calibrate the SPEECH MIC select MIC with the SIGNAL selector key ⑰.
- Press the SIGNAL key ⑰ longer than 2 seconds.
- In the middle of the display ⑱ the text SCAL appears. You see also the actual settings in % of the maximum calibration for both channels (see picture 21).
- Position yourself the customary distance from the microphone and speak test words.
- Use the left knob ② to adjust the level until the VU-meter ⑦ shows all yellow and one green light.
- If one or more red lights are on, reduce the level using the knob ②.
- Store the calibration by pressing the STIM bar ③.

5.3 Connection and calibration of the monitor phone

5.3.1 Connection of the monitor phone

Connect the monitor phone to the MONITOR connector ② at the rear panel of the MA 51 (see picture 22). To avoid pinching the cables when closing the cover, lay the cables in the slots provided. The monitor phone allows you and the patient to hear the speech test material simultaneously. This helps in determining if the test word was understood by the patient. If the talk back option of the MA 51 is installed, the communication from the patient to audiologist will be heard with the monitor phone.



Picture 22 MA 51 rear panel with MONITOR phone output

5.3.2 Adjustment of the monitor phone and talk back microphone

- To adjust the output level of the monitor phone press the receiver selector key ⑧ longer than 2 seconds.
- In the middle of the display ⑩ the text **TboP** appears. Right you see the actual settings of the monitor phone, left the setting of the talk back microphone (if installed). The settings are displayed in % of the maximum output level (see picture 23).
- Perform a test signal with Tape, CD or the speech microphone.
- Use the right knob ⑭ and adjust the output level of the monitor phone to a level that is comfortable for you.
- If you have an installed talk back microphone speak test words into the microphone and adjust the level with the left knob ②.
- Store the adjustment by pressing the STIM bar ③ or ⑳.



Picture 23 MA 51 display with adjustment of the monitor phone (right) and talkback microphone (left)

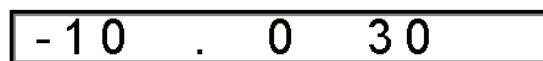
5.4 Speech Audiometry

The speech-recognition threshold **SRT** is the hearing threshold for speech. It is the lowest level at which the patient correctly recognizes the stimuli 50% of the time. Usually, recognition is indicated by repetition of the speech-stimulus item. The speech test can be done with recorded speech test material from CD or tape or with the microphone and live voice using standardized word lists. Different methods for speech tests are standardized worldwide such as the ASHA guidelines for determining the threshold level for speech (Asha 21, page 353-356).

- Explain to the patient that he should repeat each word he hears.
 - The patient should sit at a distance of at least 1 m from the device.
 - Eliminate any obstructions which will interfere with the placement of the earphone cushions on the ear (i.e. hair, eyeglasses).
 - Ensure the headphones are put on correctly. Red side on the right, blue side on the left. Adjust the headband of the headphones so that the receivers are at the correct height (the sound output grid ⊗ exactly facing the ear canal).
 - Set the receiver selectors ⑧ to AC and the signal selector ⑰ to TAPE/CD (if you are using recorded speech test material) or to MIC (if you wish to perform a speech test with live speech).
 - On the LED-display ⑱ the initial setting for speech audiometry (see picture 25) appears. The result of speech discrimination in per cent is shown in the middle.
 - If you are using CD or tape, put the monitor phone on to hear the test words.
 - Depending on your test method, use the level control knob ⑲ to set the start level.
 - Perform the test words.
 - Tally the correct words by pressing the frequency up key ④.
 - Tally the incorrect words by pressing the frequency down key ⑤.
 - If you are working online with a PC press the STIM bar ⑳ to transfer the test result to the PC (see also chapter 8).
 - To clear the counter for the next test, press the FM key ⑨.
- It is also possible to perform the speech test with loudspeakers (e.g. for the verification of hearing aid fitting) or bone conduction.
- Select the required transducer with the RECEIVER selection button ⑧ and proceed as described before.



Picture 24 Headphone



Picture 25 MA 51 display with initial settings for speech audiometry



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5.5 Masking

Speech audiometry has similar masking rules to those described in chapter 4.4 for pure tone audiometry.

When TAPE/CD or MIC is selected on one channel, and NOISE masking on the opposite channel, the MA 51 automatically performs speech masking noise.



Operating Instructions MA 51

6 Quick reference guide

6.1 Startup settings

Air conduction on both channels
Pure tone with a level of 30dB_{HL} on the right ear
Narrow band noise with a level of -10dB_{HL} on the left (masking) ear
Presenter mode

6.2 Receiver selection

Press the RECEIVER key ⑧ to select the receiver (AC, BC, FF, INSERT).
The corresponding LED above the key lights.
Not available receivers will be skipped.
After a new selection the level will be reset to 30dB_{HL} for the signal and -10dB_{HL} for masking.

6.3 Signal selection

Press either the SIGNAL key ⑰ to select the signal. The kind of masking signal of the opposite masking channel depends on the selected test signal. Narrow band noise is used for tone, speech masking noise if TAPE/CD or MIC for speech audiometry is selected.

6.4 Frequency selection

Use the frequency keys ④ and ⑤ to select the frequency. The maximum and minimum frequency depends on the receiver you have selected.

6.5 Warble tone (FM)

Press the FM key ⑨ to activate the warble tone.
Press the FM key ⑨ again to switch back to pure tone.

6.6 Pulse tone

Press the PULSE key ⑪ to activate the pulse tone.
Press the PULSE key ⑪ again to deactivate pulsing.

6.7 Test channel selection

Press the test channel selector key ⑯ to select the left or right ear for testing. For tone presentation one both ears press the channel selector button ⑯ until both LEDs **R** and **L** light. (Pressing the button ⑯ several times changes the test channel from **R** (right) to **L** (left) to **RL** (binaural) to **R** and so on).

6.8 Tracking function

Press the TRACK key ⑮ to activate tracking. The selected test channel tracks now the masking level at the opposite ear.
Press the TRACK key ⑮ again to deactivate tracking.



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6.9 STIM Mode selection

Press STIM MODE ⑭ key to switch between continuous presentation and presentation by pressing the STIM bar ⑳. When in continuous presentation mode the STIM bars ③ and ⑳ function as interrupters. The light above the STIM MODE key ⑭ is on if continuous presentation is selected.

Speech and masking noise are always in continuous presentation.

Press the STIM MODE key ⑭ again to deactivate continuous presentation.

6.10 Talk over microphone

Press the TALK OVER key ⑥. In right area of the display ⑱ the volume level of the talk over microphone is shown.

Adjust the talk forward volume with the left ② or right ⑳ knob.

Release the TALK OVER key ⑥ if you have finished talking to the patient.

6.11 Talkback microphone and Monitor volume control

Press the RECEIVER key ⑧ longer than 2 seconds.

Adjust the monitor volume with the right knob ⑳.

Adjust the talkback microphone volume with the left knob ②.

To store the actual settings press one of the STIM bars ③ or ⑳.

6.12 Speech audiometry

To select speech audiometry switch to TAPE/CD or MIC by using the SIGNAL selector key ⑰. In speech mode the display ⑱ shows in the middle the result of speech discrimination in per cent.

Tally the correct words press the frequency up key ④.

Tally the incorrect words press the frequency down key ⑤.

To clear the counter press the FM key ⑨.

6.13 Speech calibration

To calibrate the speech inputs Tape/CD or MIC select the signal you'd like to calibrate with the SIGNAL selector key ⑰.

Press the SIGNAL key ⑰ longer than 2 seconds. In the middle of the display ⑱ the text SCAL appears. Perform the reference signal with Tape, CD or microphone. Use the left knob ② and adjust the level until the VU-meter ⑦ shows all yellow and one green light. If one or more red lights are on, reduce the level using the knobs ②.



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Store the calibration by pressing the STIM bar ③ or ②③ .

6.14 User menu

To enter the User Menu you have to press the FM key ⑩ for more than 2 sec. .

To choose an item from the menu use the FREQUENCY keys ④ and ⑤.

To select the chosen item press the STIM bar ③.

Change the actual setting with the FREQUENCY keys ④ and ⑤.

To confirm the changed setting press the STIM bar ③.

To return without change press the FM key ⑩.

To return to the standard operation change press the FM key ⑩ at the user menu.

These menu items are available:

FF *	Select the calibration for the first or the second loudspeaker set
bIn	Select the signal source channel for CD/TAPE (bIn/LEft/rIght)
FrEo	Frequency roll on/off
dEFA	Default levelset 30 dB on/off
NonI	monitor phone for tone audiometry on/off
SrT	SRT-Test on/off
EL_	Electric output for FF/FF 2
STAr*	Start with AC or Insert
PrES	The signal will only be presented 1.5 s when the STIM bar is pressed
InuE	Invers function for encoders
InTE	Default setting of STIM MODE (Presenter or Interrupter)
bonE*	Activates the special MAICO Bone Masking headset (Not available in the USA)

* = only accessable if option is purchased



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7 Recommended literature

Audiometric Interpretation: A Manual of Basic Audiometry
Lloyd, Lyle L., and Harriet Kaplan
Baltimore: University Park Press, 1980

Auditory Disorders: A Manual for Clinical Evaluation
Jerger, Susan, and James Jerger
Boston: College Hill Press, 1981

Handbook of Clinical Audiology
Katz, Jack
Baltimore: William & Wilkins, 1994

Roeser's Audiology Desk Reference
Roeser, Ross J.
New York / Stuttgart: Thieme, 1996

Auditory Diagnosis
Silam, Shlomo and Carol A. Silvermann
San Diego / London: Singular Publishing Group,
1997

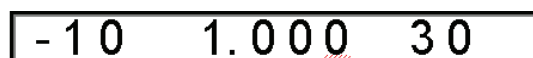
8 Computer interface

The MA 51 has a built-in serial RS 232 PC-interface for data transfer to a connected PC. The serial cable to connect the MA 51 with the PC should be a normal, non twisted 9-pin extension cable. It has a male and a female connector and all wires are direct 1:1 connected. It is also sold as monitor extension cable.

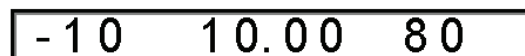
Caution: The computer you are using must meet electrical safety requirements, such as IEC 601-1, IEC 950 or UL. This is to avoid electrical shock of either the patient or you.

All test results are online transferred to the PC and stored in the database.

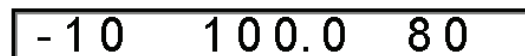
- In pure tone audiometry initially all measured data is transferred as hearing threshold data. This is indicated by the dot left from the center of the LED-display ⑱ (see picture 26).
- To test the uncomfortable level (UCL) press the test channel selector button ⑯ longer than 2 seconds and the dot moves to the center of the LED-display ⑱. All measured data is now transferred as UCL data.
- To test the most comfortable level (MCL) press the test channel selector button ⑯ longer than 2 seconds and the dot moves to a position right of the center of the LED-display ⑱. All measured data is now transferred as MCL data.
- In speech audiometry initially all measured data is transferred as multisyllable test data. The dot is left from the center of the LED-display ⑱ (see picture 29).
- To test with single syllables press the test channel selector button ⑯ longer than 2 seconds and the dot moves to the center of the LED-display ⑱. All measured data is now transferred as single syllable test data.
- To test the uncomfortable level (UCL) for speech press the test channel selector button ⑯ longer than 2 seconds and the dot moves to a position right of the center of the LED-display ⑱. All measured data is now transferred as UCL speech data.
- **Attention:**
For using the Speechtest from the NOAH MAICO Audiometry module, it is necessary that the SRT-Test is "Off"; see chapter 6.14 "user menu".



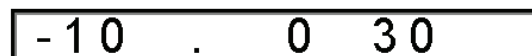
Picture 26 MA 51 display with pure tone threshold setting



Picture 27 MA 51 display with UCL setting



Picture 28 MA 51 display with MCL setting



Picture 29 MA 51 display with multisyllable speech test setting

9 Care and maintenance of the instrument

Disconnect the power plug before cleaning!

- To clean the instrument, headphones, bone conduction receiver, loudspeaker and other accessories use a soft cloth dampened with a little warm soapy water or washing-up liquid; no alcohol or spirits should be used.
- The ear cushions **Z** of the headphone can be detached for cleaning. To remove the ear cushion **Z** pull it gently from the earphone. To assemble the cleaned or changed ear cushion press it on the earphone and make sure that it sits properly. The sound outlet hole must be exactly in the middle of the earphone.



Picture 30 changing of the ear cushions

- During cleaning, please ensure that no liquid runs into the switches, level control, headphone capsules or loudspeaker openings.

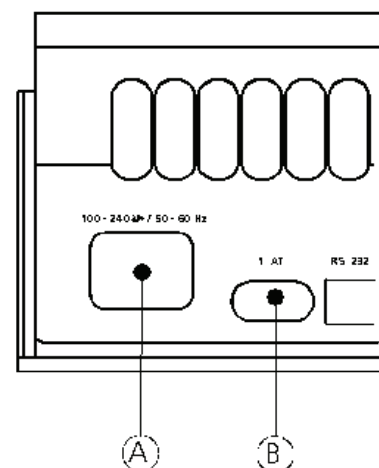
10 Trouble shooting

If you should find that your instrument is no longer working properly during a test run, please check the following points:

Diodes in the buttons do not light up and there is nothing to see on the LED-display ⑩:

- Is the power cord plugged in correctly?
- Check the power fuses ⑥ .

Disconnect the power plug, unscrew the fuses ⑥ alongside the power cord socket and check the fuses. If the wire in the glass vial is broken, please insert new fuses (1 A slow blow).



Picture 31 power socket and fuses

Diodes light up, but test tone is absent:

- Green STIM LED ① or ⑤ does not light:
- Press STIM bar ③ or ⑭ (When the diode lights up and the tone is available, the device works in presenter mode).
- Green STIM LED ① or ⑤ does light:
- Is level control ② or ⑮ set to an audible level position?
- Are the acoustic receivers connected to the correct socket?
- Is the required receiver with button ⑧ or ⑰ selected - is the correct LED lit?
- Is the lead connecting the headphones, bone conductor or loudspeaker loose or defective?

No Speechdata Transfer to NOAH MAICO Audiometry module:

- But Tone data Transfer is possible SRT-Test is on. SRT-Test must be Off; see chapter 6.14 "user menu".

If your instrument still does not work properly after this short check, please consult your dealer or service center.



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11 Technical Data



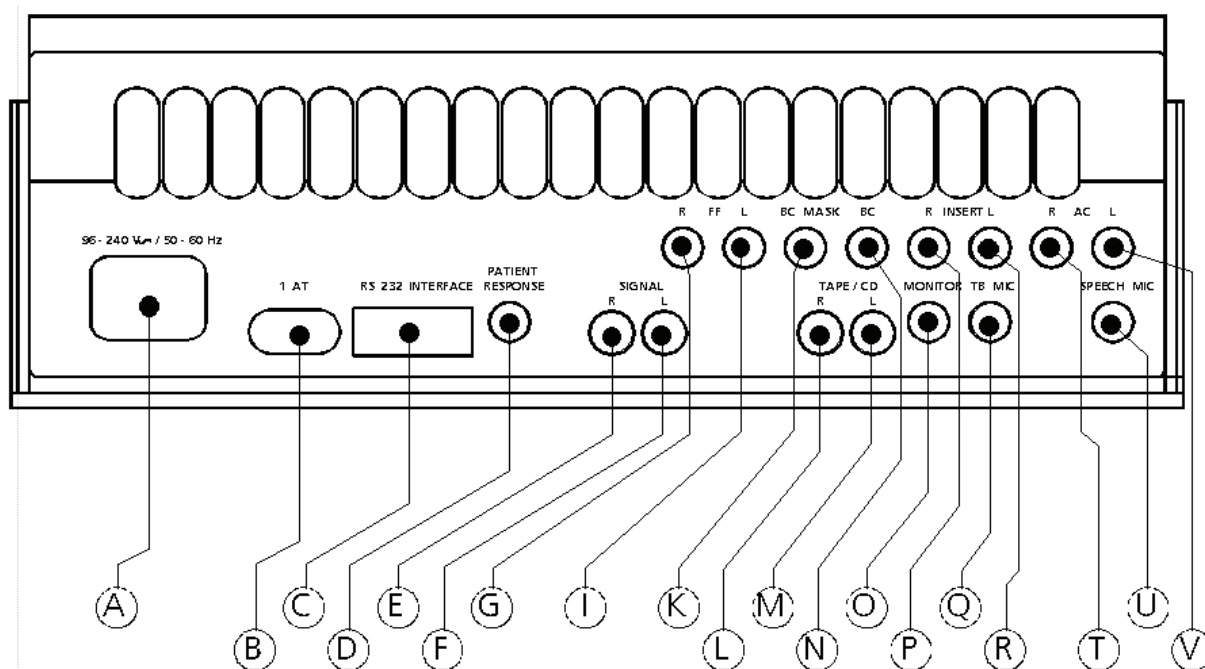
The MA 51 audiometer is an active, diagnostic medical product according to the class IIa of the EU medical directive 93/42/EEC.

Standards:	IEC 645-1/ EN 60 645-1 : Type 2 IEC 645-2 : Type A ANSI S3.6-1996 : Type 2 B
Test-Frequencies:	125 Hz, 250 Hz, 500 Hz, 750 Hz, 1 kHz, 1.5 kHz, 2 kHz, 3 kHz, 4 kHz, 6 kHz, 8 kHz
Level step:	5 dB or 2 dB level steps (user selectable)
Sound Pressure Level:	AC with earphone DD45: - 10 dBHL ... 120 dBHL (500 Hz, 4 kHz -10 dBHL ... 115 dBHL) (250 Hz, 8 kHz -10 dBHL ... 100 dBHL) (6 kHz -10 dBHL ... 110 dBHL) (125 Hz -10 dBHL ... 80 dBHL) BC with bone conduction receiver Radioear B 71: - 10 dBHL ... 80 dBHL (1000 Hz: -10 dBHL... 75 dBHL) (500 Hz, 750 Hz) (4 kHz, 6 kHz: -10 dBHL ... 60 dBHL) (250 Hz: -10 dBHL ... 45 dBHL) Insert earphone with optional EAR 3A: - 10 dBHL ... 115 dBHL (500 Hz, 4 kHz -10 dBHL ... 110 dBHL) (250 Hz -10 dBHL ... 105 dBHL) (6 kHz -10 dBHL ... 95 dBHL) (125 Hz -10 dBHL ... 90 dBHL) (8 kHz -10 dBHL ... 85 dBHL)
Modulation:	Pulse tone: 0.5 s on/off Warble tone: triangular, freq. deviation 5%, repetition rate 5 Hz
Functions:	Tone presenter / interrupter Tracking (fixed level difference between both channels)
Warm up time:	less than 10 min after power on
Environment conditions:	+ 15 ... + 35°C / + 59 ... + 95°F (operation) + 5 ... + 50°C / + 41 ... + 122°F (storage) Maximum humidity 90 % (storage and operation)
Dimensions:	W x D x H: 36 x 46 x 15 cm / 14.2" x 18.1" x 5.9"
Weight:	4.6 kg / 10.1 lbs (with accessories 5.8 kg / 12.8 lbs)
Power Supply:	100 - 240 V~ 50/60 Hz ±10 %
Power Consumption:	app. 25 VA
Device Fuses:	2x 1A slow blow



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Connection plugs:	Connection	Specification
Ⓐ power socket	left/right=power, middle=prot.GND	(100 ... 240 V~ 50/60 Hz)
Ⓑ power fuses		1 A slow blow
Ⓒ serial PC-interface	1=GND, 2=RX, 3=TX, 5=GND, 6=DTR	RS 232 C
Ⓓ patient response switch	sleeve=GND, tip=in	$R_I = 500 \Omega$
Ⓔ signal output right	sleeve=GND, tip=out	$Z_A = 47 \text{ k}\Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
Ⓕ signal output left	sleeve=GND, tip=out	$Z_A = 47 \text{ k}\Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
Ⓖ FF (loudspeaker) right channel	sleeve=GND, tip=out	$Z_A = 4 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
Ⓘ FF (loudspeaker) left channel	sleeve=GND, tip=out	$Z_A = 4 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
Ⓚ masking phone for BC (option)	sleeve=GND, tip=out	$Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$
Ⓛ tape/CD input right channel	sleeve=GND, tip=in	$Z_I = 47 \text{ k}\Omega$, $U_I = 0.04 - 5 \text{ V}_{\text{eff}}$
Ⓜ tape/CD input left channel	sleeve=GND, tip=in	$Z_I = 47 \text{ k}\Omega$, $U_I = 0.04 - 5 \text{ V}_{\text{eff}}$
Ⓝ BC (bone conduction receiver)	sleeve=GND, tip=out	$Z_A = 4 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
Ⓞ monitor phone	sleeve=GND, tip=out	$Z_A = 250 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
Ⓟ insert phone right channel	sleeve=GND, tip=out	$Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$
Ⓠ talkback microphone	sleeve=GND, tip=in	$Z_I = 1 \text{ k}\Omega$, $U_I = 0.38 - 500 \text{ mV}_{\text{eff}}$
Ⓡ insert phone left channel	sleeve=GND, tip=out	$Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$
Ⓢ AC (headphone) right channel	sleeve=GND, tip=out	$Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$
Ⓤ live voice microphone	sleeve=GND, tip=in	$Z_I = 1 \text{ k}\Omega$, $U_I = 0.38 - 500 \text{ mV}_{\text{eff}}$
Ⓥ AC (headphone) left channel	sleeve=GND, tip=out	$Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$



Picture 32 rear of MA 51 with connection plugs



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Calibration values: AC-Receiver DD 45

Force: 4 ... 5 N

Frequency [Hz]	Reference equivalent threshold sound pressure level		sound damping
	ISO 389 - 1 with Coupler IEC 318-2 [dB] (re 20 µPa)	ANSI S3.6-1 with Coupler NBS 9A [dB] (re 20 µPa)	[dB]
125	47.5	47.5	3
250	27.0	27.0	5
500	13.0	13.0	7
750	6.5	6.5	-
1000	6.0	6.0	15
1500	8.0	8.0	-
2000	8.0	8.0	26
3000	8.0	8.0	-
4000	9.0	9.0	32
6000	20.5	20.5	-
8000	12.0	12.0	24

Calibration values: BC-Receiver Radioear B 71

Force: 4.9 ... 5.9 N

Frequency [Hz]	Reference equivalent threshold force level		air radiation
	ISO 389 - 3 [dB] (re 1 µN)	ANSI S3.6-1996 [dB] (re 1 µN)	mean / maximum [dB]
250	67	67	-
500	58	58	-
750	48.5	48.5	-
1000	42.5	42.5	-
1500	36.5	36.5	-
2000	31	31	-
3000	30	30	4 / 18
4000	35.5	35.5	-
6000	40	-	10.5 / 31



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Calibration values: FF : Free sound field (0 degree incidence)

Frequency [Hz]	Reference equivalent threshold sound pressure level	
	ISO 389 - 7 [dB] (re 20 μ Pa)	ANSI S3.6-1996 [dB] (re 20 μ Pa)
125	22	22
250	11	11
500	4	4
750	2	2
1000	2	2
1500	0.5	0.5
2000	-1.5	-1.5
3000	- 6	- 6
4000	- 6.5	- 6.5
6000	2.5	2.5
8000	11.5	11.5

Calibration values: Insert phone Eartone 3A

Frequency [Hz]	Reference equivalent threshold sound pressure level		sound damping
	ISO 389 - 2 with Coupler IEC 126 [dB] (re 20 μ Pa)	ANSI S3.6-1 with Coupler HA-2 [dB] (re 20 μ Pa)	[dB]
125	26	26	32.5
250	14	14	36
500	5.5	5.5	37.5
750	2	2	-
1000	0	0	36.5
1500	2	2	-
2000	3	3	33
3000	3.5	3.5	-
4000	5.5	5.5	39.5
6000	2	2	-
8000	0	0	42.5



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Standard accessories:

- 1 air conduction receiver DD 45
- 1 bone conduction receiver Radio Ear B 71
- 1 microphone (for live speech)
- 1 patient response switch
- 1 power cord
- 1 pad of audiogram paper (50 sheets)

Optional accessories:

Loudspeaker Canton (not available in the USA)	Part.No. 801106
Portable Loudspeaker SBC (pair)	Part.No. 802092
Insert phone	Part No. 4790
Talk back microphone	Part No. 6619
Monitor phone	Part.No. 8697642565
audiogram paper (50 sheets)	Part.No.1162-417



Operating Instructions MA 51

12 Warranty, Maintenance and After-Sales Service

The MAICO MA 51 is guaranteed for 1 year.

This warranty is extended to the original purchaser of the instrument by MAICO through the distributor from whom it was purchased and covers defects in material and workmanship for a period of one year from date of delivery of the instrument to the original purchaser.

The MA 51 may be repaired and serviced only by your dealer or by a service center recommended by your dealer. We urgently advise you against attempting to rectify any faults yourself or commissioning non-experts to do so.

In the event of repair during the guarantee period, please enclose evidence of purchase with the instrument.

In order to ensure that your instrument works properly, the MA 51 should be checked and calibrated at least once a year. This check has to be carried out by your dealer.

When returning the instrument for repairs it is essential to send the headphones, as well. Send the device to your dealer or to a service center authorized by your dealer. Please include a detailed description of faults. In order to prevent damage in transit, please use the original packing if possible when returning the instrument.



Within the European Union it is illegal to dispose electric and electronic waste as unsorted municipal waste. According to this, all MAICO products sold after August 13, 2005, are marked with a crossed-out wheeled bin. Within the limits of Article (9) of DIRECTIVE 2002/96/EC on waste electrical and electronic equipment (WEEE), MAICO has changed their sales policy. To avoid additional distribution costs we assign the responsibility for the proper collection and treatment according legal regulations to our customers.



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13 Safety Regulations

13.1 Electrical Safety:



The MA 51 audiometer is constructed to comply with protection class II of the international standard IEC 601-1 (EN 60601-1). Protection from an electric shock is ensured even without the system earth connection. The instruments are not intended for operation in areas with an explosion hazard.

13.2 Measuring security:

To guarantee that the audiometer works properly, the instrument has to be checked and calibrated at least once a year.

The service and calibration must be performed by an authorized service center. In accordance with the regulations of the EU medical directive we will drop our liability if these checks are not done.

The use of non-calibrated audiometers is not allowed.

13.3 Device control:

The user of the instrument should perform a subjective instrument check once a week. This check can be done following the list for subjective instrument check (see next page). For your own security, you should copy the enclosed list, fill it in once a week and store it in your files.



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Checklist for Subjective Audiometer Testing

<ul style="list-style-type: none"> - Clean the ear and head cushion! - Untangle all lines when necessary - Are the headphone cushion in good condition? If not → replace - Are plugs and leads in good condition/ undamaged? - Are all controls working properly? - Is the Patient Response Key working properly (if available)? - Check batteries and renew if necessary? 	Instrument:..... Manufacturer:..... Serial No.:..... Examiner:.....
---	--

Test Signal Quality

All the test frequencies in the below table indicate typical hearing level and can be changed when necessary:
Masking: "B" for Buzz tone, "G" for Noise, "V" for signal distortion, "S" for switching masking noise.

	Right Ear								Level	Left Ear								
kHz	0,25	0,5	1	2	3	4	6	8		0,25	0,5	1	2	3	4	6	8	kHz
LL									30dB HL									
									50dB HL									
									70dB HL									
KL									30dB HL									
									50dB HL									

- * When noise "B", "G", "V" or "S" is blocked, inform the service center!
- * When the test tone is heard at the masking ear, contact the service center!

Air Conduction Audiogram

	Right Ear								Level	Left Ear								
kHz	0,25	0,5	1	2	3	4	6	8		0,25	0,5	1	2	3	4	6	8	kHz
									Should dBHV*									
Left Earpiec									Is dBHV									Left Earpiec
Right Earpiec									Is dBHV									Right Earpiec

- * Should is the last measurement of the patient
 - **For inverted measurement please reattach the headphone
- If the frequency difference between „Should“ and „Is“ for one ear averages more than 10 dB, contact the SERVICE CENTER!

Bone Conduction Audiogram

	Right Ear								Level	Left Ear								
kHz	0,25	0,5	1	2	3	4	6	8		0,25	0,5	1	2	3	4	6	8	kHz
									Should dBHV*									
									Is dBHV									

If the frequency difference between „Should“ and „Is“ for one ear averages more than 10 dB, contact the SERVICE CENTER!

Tested..... Date:.....



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Specifications are subject to change without notice.



MAICO Diagnostic GmbH
Salzufer 13/14
1058 Berlin
Telefon +49 3070 71 46 50
Telefax +49 30 70 71 46 99
e-mail: export@maico.biz
Internet: www.maico.biz